Application of a new model of density layers of matter to the expanding gaseous envelope of the star HD 175754

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1. Introduction

HD 175754 is a luminous supergiant star of spectral type OeIIf with effective temperature 31800 ±1100 K (Morossi and Crivellari, 1980). Costero and Stalio (1981) and Costero et al (1981) studied the NV, SiIV and CIV profiles of this star and compared them with the profiles of similar type stars. They found individuality, which implies different structures and dynamics of the atmospheric layers above the photosphere. Carrasco et al. (1981) reported only small changes in the UV resonance line profiles. They interpreted them in terms of variations in dynamics and density/ionization structure of the stellar wind. Lamers et al (1982) noted the possibility of the presence of satellite components superimposed on the wide P Cygni profiles of the UV resonance lines. Finally, Franco et al (1983) studied the P Cygni profiles of the above resonance lines of HD 175754 observed at different epochs and they reported variability at the secondary satellite component.

The atmospherical model

Considering an area of gas consisting of i independent absorbing shells followed by a shell that both absorbs and emits and an outer shell of general absorption, we conclude to the function:

$$I_\lambda = \left[I_{\lambda 0} \exp\left\{-L_{\lambda e}\xi_e\right\} \prod_i \exp\left\{-L_i \xi_i\right\} + \Theta_0\left(1-\exp\left\{-L_{\lambda e}\xi_e\right\}\right)\right] \exp\left\{-L_{\lambda g}\xi_g\right\}$$

where: $\mathbf{I_{\lambda 0}}$: the initial radiation intensity, $\mathbf{L_i}$, $\mathbf{L_{\lambda e}}$, $\mathbf{L_{\lambda g}}$: functions of the rotational and the expansion/contraction velocities (vsini, $v_{ex/c}$),

$\xi = \int_0^s \Omega \rho ds$ where $\mathbf{\Omega}$: an expression of k_λ, $\mathbf{\Theta_0}$: the source function $S_{\lambda e}$, which, at the moment when the spectrum is taken, is constant and

$L = \sqrt{1-\cos^2\theta}$, if $\cos\theta_0 < 1$, or

$L = 0$, if $\cos\theta_0 \geq 1$

where: $\cos\theta_0 = \dfrac{-\lambda_0 + \sqrt{\lambda_0^2 + 4\Delta\lambda^2}}{2\Delta\lambda z_0} < 1$

where: λ_0 is the wavelength of the center of the spectral line and $\lambda_0 = \lambda_{lab} + \Delta\lambda_{\exp}$, where λ_{lab} is the laboratory wavelength of the spectral line and $\Delta\lambda_{exp}$ is the radial Doppler shift and $\frac{\Delta\lambda_{\exp}}{\lambda_{lab}} = \frac{v_{\exp}}{c}$

$z_0 = \frac{v_{\exp}}{c}$, where v_{exp} is the apparent rotational velocity of the i density shell of matter.

$\Delta\lambda = |\lambda_i - \lambda_0|$, where the values of λ_i are taken in the wavelength range we want to reproduce.

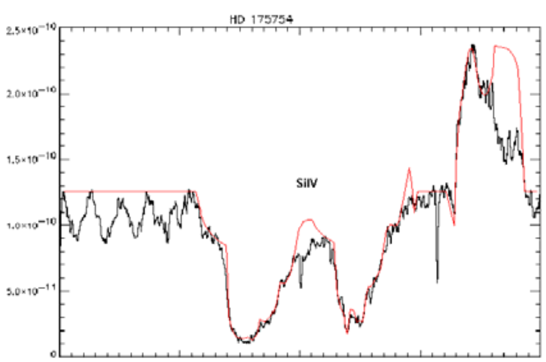
The UV data

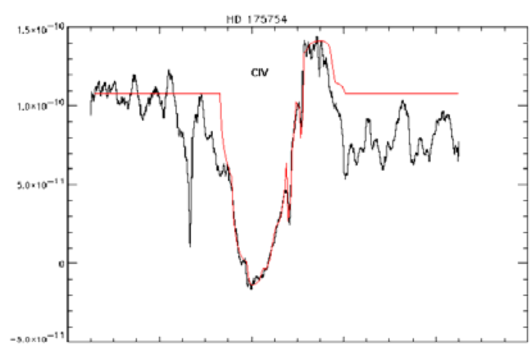
In this project the coronal region's study of O8eIIf star HD 175754 is based on the IUE spectrum SWP 1483 taken on August 24th. 1981 and we study the structure of the spectral lines of:
SiIV λλ 1393.755 A, 1402.730 A., NV λ 1718.55 A, CIV λλ 1548.18 A, 1550.77 A, NIV λλ 1238.821 A, 1242.804 A.

Tables and Figures

The following figures illustrate the spectral lines and the best fit using the model we described. The tables below the figures show the radial velocities of expansion or construction as well as the apparent velocities of rotation of all the observed layers of matter. The diagrams represent the radial velocities of expansion or construction and the apparent velocities of rotation of all the observed layers of matter as a function of atmospherical depth.

The model' fit





1. Each of SiIV λλ 1393.755A. 1402.73A resonance lines of HD 175754 shows a clear (characteristic) P Cygni profile Which is formed as a composition of 5 independent absorption and one emission components.
2. Each of CIV λλ 1548.185A, 1550.774 resonance lines of HD 175754 shows a clear (Characteristic) P Cygni profile Which is formed as a composition of 2 independent absorption, one emission and one general absorption components.

	V_{a1} (Km/sec)	V_{a2} (Km/sec)	V_{a3} (Km/sec)	V_e (Km/sec)
NV λ 1238.821 A	-1729	-1022	+73	+1431
NV λ 1242.804 A	-1738	-1007	+100	+1426

	V_{a1} (K/s)	V_{a2}(K/s)	V_{a3} (K/s)	V_{a4} (K/s)	V_{ga} (K/s)	V_e (K/s)
NIV λ 1718.55 A	-375	-364	-194	-26	-45	+381

	V_{a1} (Km/sec)	V_{a2} (Km/sec)	V_{ga} (Km/sec)	V_e (Km/sec)
CIV 1548.18 A	-2063	-955	+19	+1050
CIV 1550.77 A	-2058	-977	+15	+1050

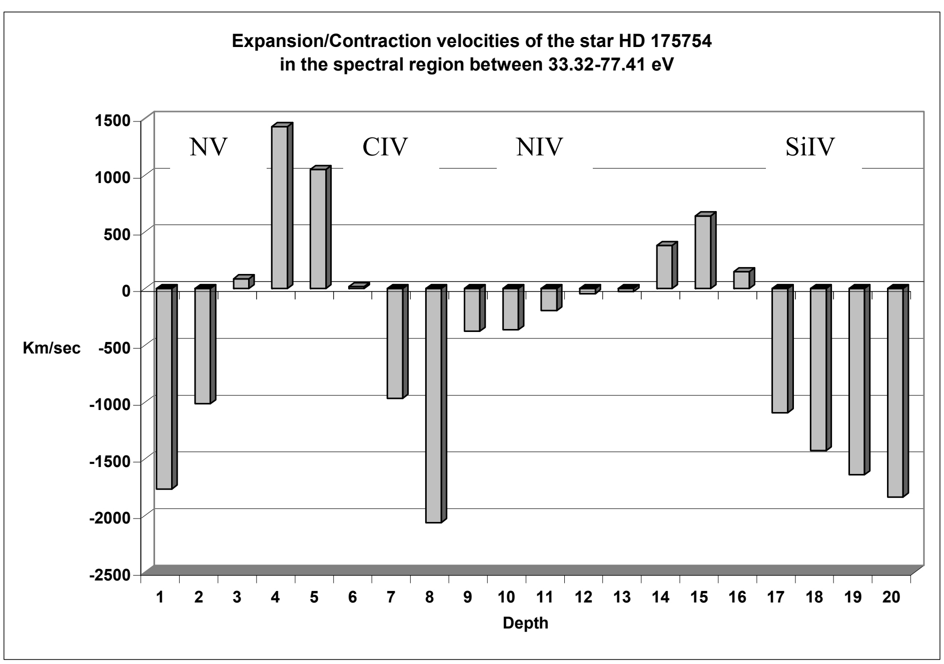
	V_{a1} (K/s)	V_{a2}(K/s)	V_{a3} (K/s)	V_{a4} (K/s)	V_{a5} (K/s)	V_e (K/s)
SiIV 1393.755 A	-1853	-1658	-1461	-1104	+175	+625
SiIV 1402.73 A	-1821	-1621	-1395	-1083	+122	+659

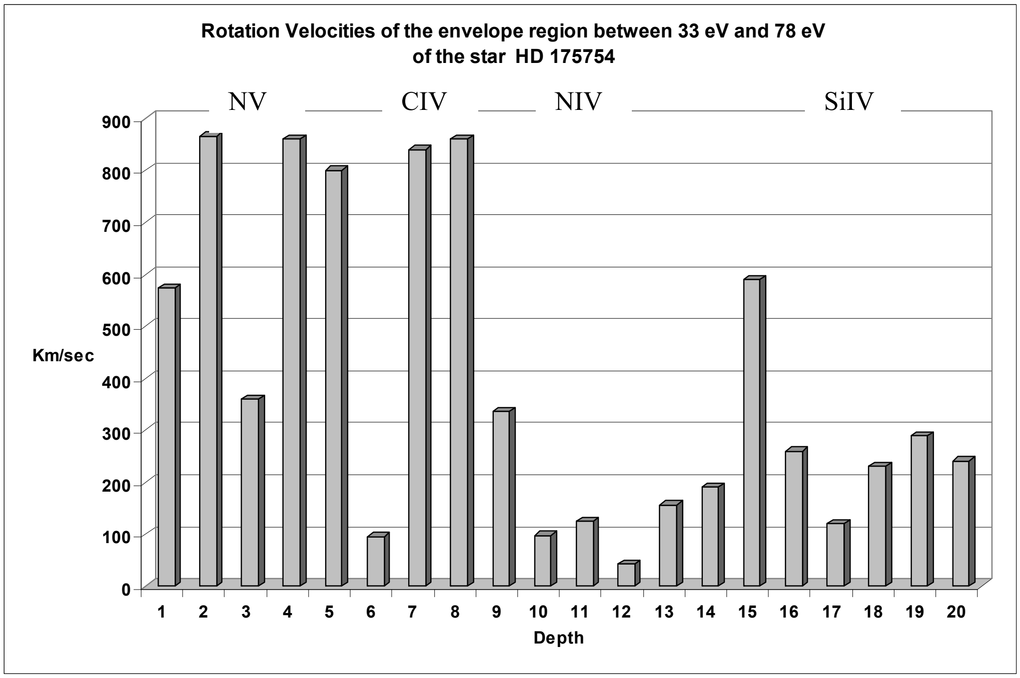
	V_{rot1} (Km/sec)	V_{rot2} (Km/sec)	V_{rot3} (Km/sec)	V_{rote} (Km/sec)
NV λ 1238.821 A	573	866	360	863
NV λ 1242.804 A	573	866	360	860

	V_{rot1} (K/s)	V_{rot2}(K/s)	V_{rot3} (K/s)	V_{rot4} (K/s)	V_{rotga} (K/s)	V_{rote} (K/s)
NIV λ 1718.55 A	336	98	125	43	156	190

	V_{rot1} (Km/sec)	V_{rot2} (Km/sec)	V_{rotga} (Km/sec)	V_{rote} (Km/sec)
CIV 1548.18 A	860	840	100	800
CIV 1550.77 A	860	840	90	800

	V_{rot1} (K/s)	V_{rot2}(K/s)	V_{rot3} (K/s)	V_{rot4} (K/s)	V_{rot5} (K/s)	V_{rote} (K/s)
SiIV 1393.755 A	241	289	200	170	260	590
SiIV 1402.73 A	241	289	230	170	170	590





Conclusions

1. The best fit of all lines derived by the model we described lead to the conclusion that the layer of matter in the region we studied (33eV-70eV) is structured as the model describes:

a. An area of gas consisting of I independent absorbing layer of matter.

b. One emitting layer of matter following the absorbing layers.

c. Occasionally, an external general absorption layer of matter.

2. The presence, in the region we study, of succesive shells that expand or contract with velocities between –2063 Km/sec and +1431 Km/sec, while the apparent rotation velocities, in this region, vary between 860 Km/sec and 430 Km/sec, is a very interesting conclusion.

Acknowledgements

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